Gas Journal

VOL. 297. 111th YEAR LONDON, MARCH 25, 1959 No. 4993 PRICE 1/6

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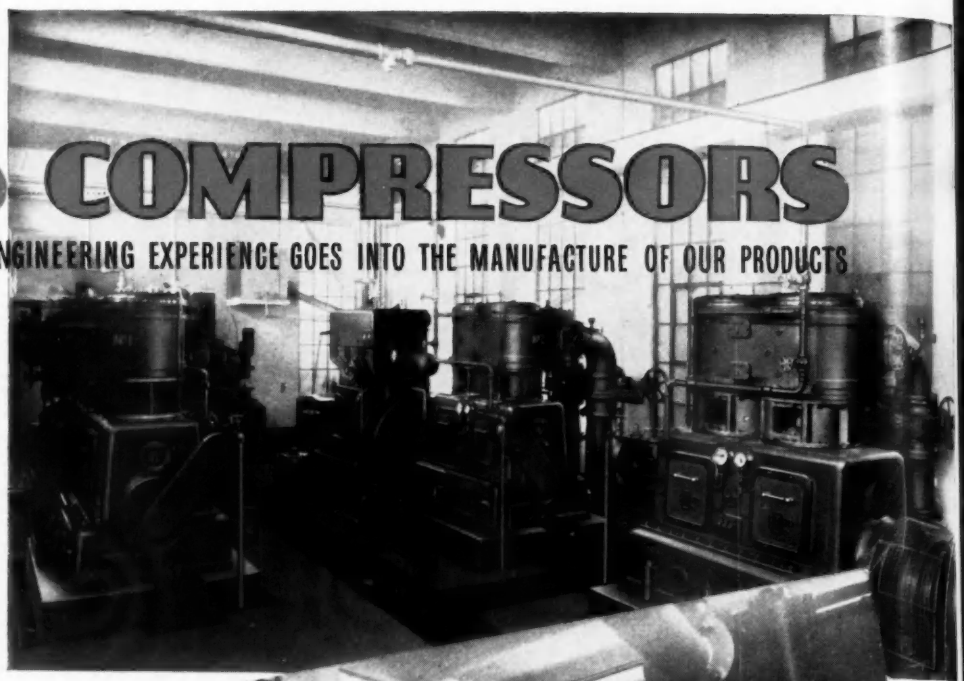

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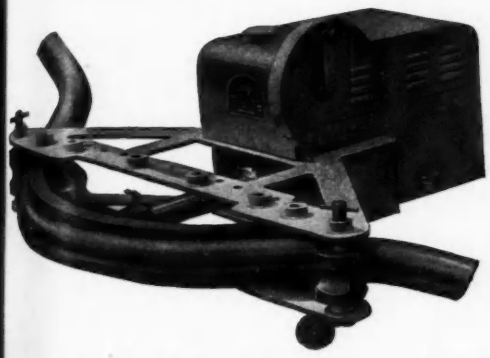

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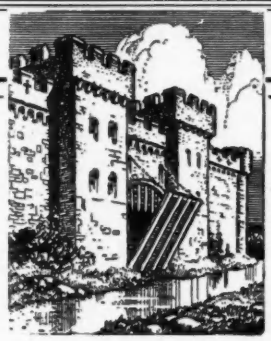

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Gas Journal

VOL. 297 No. 4993 MARCH 25, 1959

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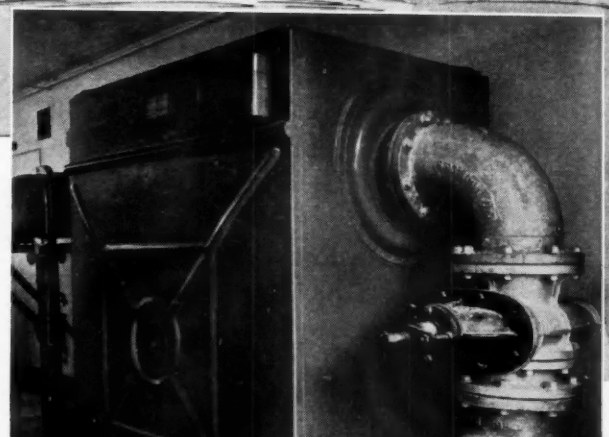

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Gas Journal

VOLUME 297. No. 4993 MARCH 25, 1959. 111th YEAR

The Training of Gas Engineers

As techniques in industry become more complicated, so does it become more important that both engineers and technicians should be sufficiently well trained fully to exploit them. Gone are the days of rule of thumb methods and no longer can the purely practical man with years of experience of his particular industry behind him hope to run his plant competitively or at the lowest possible cost without employing new techniques. Today engineering, craftsmanship and management fall into almost water-tight compartments. So complicated has each become, that it is difficult to pass from one to another. Anyone starting his career in industry must receive special training for the particular 'stream' he either wishes or is compelled to enter by his mental make-up or abilities.

The importance of the proper and complete training of professional engineers has been recognised for many years by the engineering institutions, but it would seem that it is only since the last war that developments in mechanical, plant and electronic engineering particularly have shown the need for better qualified engineers and technicians. There is little doubt that the great depression of the early 1930's, which was still felt in 1938, was responsible for young men being discouraged from entering the technical sections of industry. With the end of the war many large firms realised the need for training schemes for both engineering apprentices and the university graduate, who represented the craftsman, the engineer or even the manager of the future.

By the Gas Act of 1948, the recently nationalised gas industry was charged with the duty of adequately training all those coming into the industry as engineers or craftsmen.

As the regulating body for professional standards in the gas industry, the Institution of Gas Engineers is responsible for the educational and examination standards for all those aspiring to corporate membership, and, therefore, no one could be better qualified to speak on these matters than Mr. A. G. Higgins, its Assistant Secretary. Mr. Higgins, in a paper to the London Juniors, 'Education and Training for Gas Engineers,' gives a full account of the Institution's activities in the field of education in the present century.

The earliest efforts in the organised training of engineers and technicians in the industry was undertaken by the Society of Arts—later the Royal Society of Arts—in the early 1870's to be superseded a few years later by the newly founded City and Guilds of London Institute, which began courses for gas engineers in 1878. In the early part of the present century the Institution of Civil Engineers—the oldest engineering institution—decided to set up a committee on which all the other similar institutions would be represented, to study the proper training of engineers in this country, whichever their specialised branch might be. This was the beginning of the organised schemes for laying down the professional standards in the gas industry and framing the necessary examination syllabuses. The connection between our Institution and the 'Civils' is still very strong and the first part of the present examination for associate membership is common to both. In this way standards were set, but it was very much left to the young man himself to get his own training. If he was fortunate he was able to qualify himself by whole time study at a university or technical college taking a course in the necessary subjects, but if already in the industry attendance at night schools after a hard day's work was the only means open to him. Employers might or might not encourage him but clearly they were glad to have a qualified young man on their books.

Between the wars, the type of young man entering industry changed. The public school boy with or without a university education was beginning to be employed by industry; he was not necessarily the proprietor's son. He needed some form of training in the firm's activities before the advantages from a settled and assured background and a good general education could be brought out to the full benefit of the firm or himself. This was recognised at the time by some of the largest industrial firms but it was not until after the war that such a state of affairs was universally accepted. The gas boards were particularly quick to take up the idea and, since training officers had been appointed to administer the educational obligations of the Gas Act, full scope under expert guidance could be given to making full use of the material available. By instituting sandwich courses at local technical colleges, by releasing apprentices for one whole day a week to attend courses of instruction

in addition to night school study, and even the setting up of a residential college for short courses, the area boards have shown how greatly they value the potential manpower available and how determined they are to develop it.

What is the future going to demand of the gas engineer in an ever changing world? The gas industry of today demands a number of specialist engineers, including chemical as well as civil, mechanical and electrical engineers, and qualified chemists. Will there be any call for gas engineers as we understand them today? Undoubtedly the character of the industry is altering with the perceptible change from carbonisation to other forms of gas making, but if a specialist engineer is employed in the gas industry he will do well to give his loyalty to that industry and become a member of the Institution. The presence of many specialists coming together to listen to another's point of view affecting their industry, both widens the scope of the gas industry and improves its technical standards. In fact, the proportion of corporate members of the Institution,who are members of other professional institutions and institutes is higher than in other similar bodies.

Are the technical qualifications for admission to our Institution as high as to any other or will it become a kind of club for qualified engineers and chemists from more famous professional bodies? This we think is extremely unlikely. The efforts of the Educational Committee have made it quite clear by the standards set for the associate membership examination and by the qualifications needed for full membership, that corporate members of our Institution can stand on equal terms with other specialist engineers. This was amply demonstrated by the Institution's success in winning full recognition by Government departments after the war.

Warm Air Heating

THE winter just past—well, almost past—was significant in that it showed the first hardening of intention on the part of the gas industry in its new-found interest in the space heating load. Having belatedly realised that this constitutes the obvious solution to the problem of less clearly defined superiority in the field of cooking, gas boards made a determined effort to step up sales of heating appliances—aided of course by some help from the Chancellor and a more or less co-ordinated publicity campaign. So far, so good. But we have detected on the part of the sales side a tendency to take the line of least resistance and sell radiant convector fires which, although admirable for many purposes, are not necessarily the only weapon in Mr. Therm's armoury. The industry's aim must be to seek the whole heating load of a house rather than that of only one or two rooms. Particularly in the case of new property gas has a great deal to offer and has nothing to fear on the grounds of running costs. Admittedly the capital cost of such systems is usually higher, but this can be included in the mortgage and the speculative builder is provided with an attractive sales point, one likely to appeal to those desiring higher standards of comfort and reduced labour.

One of the most attractive and potentially valuable types of heating service which the industry has to offer is that of warm air; already three manufacturers offer equipment of this kind. Last week we inspected one of the growing number of warm air installations, at Rosehill, Stockton-on-Tees, where 90 houses are to have Radiation Ductair heating. In this thermostatically controlled system air is drawn through ceiling grilles and passed through a heater. It is then blown in insulated ducts to skirting-level registers for discharge into the areas to be warmed. Its merits include uniformity of temperature distribution, flexibility and ease of control, the elimination of stuffiness, freedom from local colouration of decorations, compactness, and equal suitability for free or open planning.

We asked the owner of the first occupied house (roughly 1,400 ft. super) about her gas bill for the first quarter (November to January). With gas at the Northern Gas Board's competitive tariff of 1s. 3d. a therm it worked out at 29s. 6d. a week, including cooking—this for a good standard of heating in lounge and dining room with background heat to the kitchen, hall and two of the three bedrooms. This she considered reasonable in view of the comfort conditions obtained. It is anticipated that in summer the bill for water heating alone will be about 6s. a week. Incidentally, it is worth mentioning that the quarterly bill for electric floor warming in another house on the estate was greatly in excess of this figure, so much so that the system was not being used. (A full-scale feature on this Ductair installation will appear in the April issue of *Gas Service*.

This is only one of many similar installations in various parts of the country which bear witness to the great potential for this type of heating. It has been amply shown that warm air heating is a sound proposition on the domestic market, but as yet it is fair to say that the spade work has been done by the manufacturers, both in training heating engineers in the use of the equipment and backing this up with a comprehensive technical service. It is obvious that if the system is to develop and achieve its real potential both the heating engineers and the gas boards must achieve a larger measure of independence. As far as the gas boards are concerned this can only be done by investment—investment in properly qualified draughtsmen and designers who can back up the efforts of the representatives. Speculative builders and architects can be interested in warm air heating but they require a high measure of co-operation. If the necessary support is not forthcoming they will quickly lose interest and turn to some other system the sponsors of which are prepared to provide the necessary assistance. Moreover, sales representatives must be trained in how best to present the case for this type of service and in the way in which it can be installed most efficiently. Some preliminary work has been done in this direction at Watson House; no doubt further facilities will be provided when there is the appropriate demand from the gas boards.

In our view there is no finer way of staking our claim in the future domestic heating load than the stimulation of sales of warm air equipment; once it is installed in a house only a very serious worsening of the competitive position of gas would cause the owner to replace it. And the load is exactly the type of load that the industry requires for future stability.

Personal

The following area gas board Chairmen have been re-appointed by the Minister:—DR. R. S. EDWARDS (North Eastern), MR. M. MILNE-WATSON, C.B.E. (North Thames), MR. E. CROWTHER, C.B.E. (Northern), MR. W. K. HUTCHISON, C.B.E. (South Eastern), and MR. C. H. CHESTER, C.B.E. (South Western). MR. G. E. CURRIER, O.B.E. (North Eastern) and MR. J. CARR, O.B.E., M.C. (South Western) have been re-appointed as Deputy Chairmen. The following have been re-appointed full-time members of their boards:—MR. A. MCDONALD (North Eastern), and MR. H. BUTTERS (North Western). Part-time board re-appointments are: SIR ERIC CARPENTER, O.B.E., and MR. W. W. B. STODDART (North Western), MR. J. W. NAPIER and MR. G. CALDER (Eastern), PROFESSOR A. L. ROBERTS, MR. J. OWEN, and MR. R. WALTON (North Eastern), MR. G. D. DILLON (North Thames), COLONEL H. HASWELL PEILE, O.B.E. (Northern), MR. K. W. HICKMAN and MR. TOM BROWN (South Eastern), ALDERMAN H. E. WRIGHT and MR. L. EASTERBROOK, O.B.E. (South Western), SIR JOHN GREEN, SIR EDWARD HERBERT, O.B.E., and GEOFFREY BARNETT (East Midlands) and MR. S. V. SMITH (Southern).

MR. R. P. CHESTER, who has been Chairman and Managing Director of Donald Macpherson & Company since 1923 and who reached the age of 70 last month, was re-elected to the Board at the recent annual general meeting. Mr. Chester has been with the company since 1911.

MR. A. J. PEARSON, District Service Manager at Crewe for the North Western Gas Board, has had his district extended to include Nantwich and Sandbach. MR. J. W. WELBOURN, District Service Manager for Nantwich, Malpas and Whitchurch, has been appointed Housing and Sales Officer to the Mid-Cheshire Group at Northwich.

MR. ALAN SANDERSON has been appointed Sales Manager of Blaw Knox Chemical Engineering Co., Ltd. He has experience in the heavy engineering and process plant industries gained during his employment with plant suppliers, consultants and process operators.

Salt mine storage send-out plan begins to operate this week

MORE details have become available about the underground gas storage scheme at Billingham-on-Tees mentioned in last week's issue.

Some two years ago it was decided, in conjunction with Imperial Chemical Industries, to develop an underground cavity in a salt stratum for the purpose of storing coal gas under pressure. Work on this project commenced in August, 1956, but, unfortunately, the first borehole had to be abandoned owing to unsuitable strata.

The second bore was commenced in January, 1957, and sunk to a depth of 1,290 ft. Washing out of the brine followed and this was completed in January, 1959. During the period of sinking the borehole, a compressor station was erected some ¼ mile away from the site of the well, and the 6-in. gas main from the well to the compressor station, and the 10-in. main from the compressor station to the distribution system were completed.

The compressing plant consists of two Peter Brotherhood three-stage electrically-driven compressors each of 1,000 cu.ft. per minute capacity together with an electrically-driven booster or fourth stage machine to lift the pressure from the main compressors from 440 p.s.i.g. to 760 p.s.i.g.

Continuous pumping of gas into the cavity was begun on February 5, 1959, and by February 26, 1959, approximately 17 mill. cu.ft. of gas was stored at a pressure of 711 p.s.i.g. In order to test the soundness of the cavity this pressure was maintained for seven days, after which, on March 6, the Northern Gas Board commenced delivering gas direct to the district.

During the past few weeks the pressure reducing and volumetric governors have been tested and these have given every satisfaction.

The originally envisaged regular sequence of placing gas into storage over the week-ends began last Friday and the stored gas will be released to the district during this week.

So far everything has gone according to plan and it is hoped, in due course, to assess fully the economics of this experiment.

O.E.E.C. COMPILES GAS-MAKING BIBLIOGRAPHY

THE Gas Committee of the Organisation for European Economic Co-operation, Paris, instructed a group of experts to compile very detailed bibliographical references on the techniques and economic efficiency of the various processes for producing gas from the different raw materials used in O.E.E.C. member countries.

The group of experts has now completed this important work, which is presented in the form of a collection of bibliographical references covering everything written in Europe since 1950 on the following subjects: Distillation and gasificaton of solid fuels, use of petroleum products (liquid) and liquefied petroleum gases, use of natural gas and firedamp, use (direct or after processing) of refinery tail gases, treatment of gases.

The information given in these bibliographical references has been indexed in a catalogue of 94 roneotyped pages, which makes it easy for the reader to find any subject which he may particularly wish to study.

Copies of this catalogue and of any of the bibliographical references it contains are obtainable free of charge on application to the Secretariat of the Gas Committee, O.E.E.C., Château de la Muette, Paris, 16ème.

Obituary

MR. REGINALD GARROW DE HAVILAND HOSKYNS, of South Petherton, Somerset, has died aged 81. Mr. Hoskyns was a chairman of the former Martock Gas Company. When the Martock Gasworks was founded in 1900 he became its chairman and managing director, posts which he continued to hold until the works were nationalised in 1948.

MR. WILLIAM EWING, the last manager of Falkirk gasworks before nationalisation, has died in Falkirk at the age of 64.

MR. EDWARD JAMES SANDERS, former chief clerk at Congleton Gasworks, and before that assistant manager there, has died, aged 67.

MR. REGINALD R. WEBSTER, who had been an engineer with the A.P.V. Co., Ltd., for 26 years, has died aged 62. Mr. Webster represented his company in the chemical, oil and varnish and distillation industries among whose members he had very many friends.

Diary

March 26.—NORTH THAMES G.C.C.. City Hall, Westminster. Council Meeting.

March 26.—INSTITUTION OF PLANT ENGINEERS. SHEFFIELD GROUP: Grand Hotel, Sheffield. 'Refractories' by T. R. Lynam of the Oughtbridge Silica Brick Co., Ltd. 7.30 p.m.

March 26.—INSTITUTE OF FUEL, MIDLAND SECTION: Stephenson Place, Birmingham 2. 'Coal Marketing and Associated Problems' by R. A. Howson. 6.30 p.m.

April 3. — LONDON AND SOUTHERN JUNIORS: Symposium on 'Butane Storage and Use of Butane,' by A. A. H. Clark and L. A. Warren (N.T.G.B.), and 'Utilisation Aspects of the Addition of Butane to Town Gas,' by M. G. Gilbert and F. C. Moody (Watson House).

April 4. — LONDON AND SOUTHERN JUNIORS. — Afternoon visit to Beckton.

April 7.—SOUTH EASTERN G.C.C.: Caxton Hall, Westminster. Council meeting. 11 a.m.

April 8.—INSTITUTE OF FUEL, NORTH-WESTERN SECTION: Engineers' Club, Albert Square, Manchester 2. Annual General Meeting. 2.15 p.m.

MORE AUTOMATION, FEWER WORKS

Southern Board's quarterly report stresses change

THE Southern Gas Board had 42 of its 74 holder stations operating with automatic 'unmanned' equipment at December 31 last, the Board reports to the Gas Consultative Council. In their bulletin to the council for the quarter ended on that date, they also state that seven gasholders were taken out of commission, leaving 136 in operation; satisfactory progress was made on the erection of new holders at Cowley and Basingstoke.

The Board closed three of its smaller works during the quarter (Banbury, Bognor and Weymouth) leaving 11 works still in operation. The average size of these remaining works is among the highest of all boards in the country. The use of refinery gas from Fawley was increased to the maximum. Virgin naphtha was introduced as a feedstock at Hilsea works where it was in continual use from December 1, effecting considerable saving due to its low cost as a raw material.

Up to schedule

At Reading the erection of the Segas plant and new purifiers progressed satisfactorily and is up to schedule. The compressor house foundations were completed and a start made on the foundations for the dry gas plant.

Continuous work was undertaken to improve gas supplies by clearing or relaying district mains. During the quarter, 30 miles of main were laid and one mile disconnecetd and abandoned, bringing the total length of main in use at December 31 to 5,813 miles.

The recently published 1957 report of the Portsmouth city analyst refers to a survey of sulphur dioxide pollution in the vicinity of the Hilsea works, correlated with the help of the Board, with the periods of operation of the Onia-Gegi plant. The conclusion was reached that there was no evidence of increased pollution due to this plant. Throughout the year sulphur dioxide was low and compared favourably with the least contaminated areas in the country. The city analyst commented that smoke in Portsmouth was largely derived from domestic chimneys.

The Board report that the work of examining gas installations in the homes of old people living alone is being carried out steadily and continuously. Another 630 such installations were checked and left in good order, making a total of 14,500 since the Board introduced the service.

The net increase in gas services laid during the quarter was 3,160. The number of services renewed reached a total of 2,344.

Less gas sold

With average temperatures 3.1° higher sales of gas were 28,454,000 therms compared to 30,484,000 therms for the corresponding quarter in 1957. Sales of gas appliances, however, showed a steady upward trend being over 50% up on the same quarter in 1957. All types of appliances, except coke grates, contributed to the increase.

For the nine months to December 31, total sales of major appliances were 31.2% up on the first nine months of 1957.

Cost control

A new approach to cost control is being pioneered by the Southern Gas Board in connection with a scheme based on an analysis of fitters' time and costs. For the first time cost control sampling and analysis are to be carried out on an electronic computer, making use of the Pegasus computer at Southampton University, and it is considered that the experiment is the forerunner of important developments for the gas industry and industry generally.

N.G.B. BUILDING NEW 8-MILL. GASWORKS

THE Northern Gas Board are building a coal carbonising plant at Hendon gasworks, Sunderland, which will be capable of producing 8 mill. cu.ft. of gas daily. The plant is due to come into operation in the autumn of 1960 and will replace two carbonising plants which have been in use for nearly 100 years. At present, some of the gas consumed at Sunderland is obtained from Lambton and Murton coke-works, but when the Hendon plant is ready, the amount of gas needed from outside the area will be greatly reduced.

British Oxygen

The British Oxygen Co., Ltd., in the statement of accounts for the year ended September last, shows an unappropriated profit of £1,381,450. This represents an increase on last year's figures of £320,713. The directors recommend payment to the ordinary shareholders of 6%, less income tax.

Senior officers attend domestic space heating course

A photograph taken during the course at Watson House.

A TEN-DAY training course held at the Gas Council's Watson House Centre recently was an attempt to bring all the gas boards up to date and have discussions on the various methods of providing domestic space heating—particularly for flats—and on the latest flue systems such as Se-duct, branch flues, and individual flues. It was a 'one off' course, and the boards sent along senior officers who would be able to make full use of the information given.

Most of the lectures were given by Dr. F. J. Eaton, Mr. D. R. Wills, and Mr. G. H. Purkis, supported by members of their staff at Watson House. The course also included visits to practical installations in the district, to the South Eastern Gas Board laboratories, and to four manufacturers.

One day was given to the commercial and practical aspects of district installation and the invited speakers on this day were Mr. N. R. Junkison (N.T.G.B.), Mr. E. Wulstan Atkins (S.E.G.B.), Mr. R. S. Taylor (N.G.B.) and Mr. R. H. Anderson (N.E.G.B.)

Women demand re-appraisal of purchase tax

THE Women's Gas Federation has organised a petition to the Chancellor of the Exchequer by principal women's organisations representing 785,492 members with an additional 1½ mill. membership through affiliated societies. The petition is as follows:

1. Purchase tax, which was originally introduced as a war-time measure, is still in force as a source of revenue and appears to be in danger of becoming a permanent part of the tax system.

2. Housewives have borne far too long the disproportionate burden of purchase tax on equipment essential to the economic running of the home. This is a direct tax on necessities large and small and on labour saving appliances, all of which are tools of the housewife's trade.

3. The following organisations feel that the removal from household equipment of the purchase tax which vitally affects every home in Great Britain, is due for further consideration by the Government, and urge the Chancellor to take immediate steps to ensure that those responsible for the management of the home are no longer penalised by this tax: National Federation of Women's Institutes, National Union of Townswomen's Guilds, National Council of Women of Great Britain, Women's Co-operative Guild, National Association of Women's Clubs, Women's Advisory Council on Solid Fuel, Electrical Association for Women, and the Women's Gas Federation.

Small bore heating

Mr. E. E. Blandon, Research and Development Manager and a director of Thomas Potterton Ltd., the boiler manufacturers, was recently invited to give a lecture on boilers for small bore heating systems at the building symposium of Woolwich Polytechnic. He discussed Potterton boilers generally and their suitability for use with this type of heating system, with particular reference to the new Diplomat small bore units which have recently been introduced.

M.O. talks to women

Mrs. J. Sellars presided at the February meeting of the Hull branch of the Women's Gas Federation. Members heard a talk on the prevention of tuberculosis given by Dr. A. H. Fairlamb, assistant medical officer of health.

Change of address

West's Gas Improvement Co., Ltd., announce that from today the Midland area office will be at: Griffin House, 18/19, Ludgate Hill, Birmingham, 3. Telephone: Central 1416.

Glasgow housewives may be obstacle to smokeless zone

MORE than 300 delegates appointed by local authorities and industrial and commercial organisations attended a clean-air conference in Glasgow last week. The speakers were: Dr. Ian MacGregor, Department of Health for Scotland; Mr. W. B. Kennedy, Senior Smoke Inspector, Manchester; Mr. A. Marsh, Director of the National Society for Clean Air; and Dr. W. A. Macfarlane, Managing Director of the National Industrial Fuel Efficiency Service.

COMMITTEE TURN DOWN *FREE* GAS CONNECTIONS

Despite an offer by the Scottish Gas Board to install gas connections free of charge in new multi-storey flats to be built in the Hutchesontown-Gorbals redevelopment area of Glasgow, the Housing Committee of Glasgow Corporation has decided to re-affirm a previous decision to make the first 1,000 of the 7,000 houses all-electric.

Floor-heating

The offer related to 428 and 400 houses in two sections. Like the completed section of 96 houses, these are to have floor-heating by electricity and the committee decided that the suggested change in plan could not be made at this stage.

The question of allowing freedom of choice between gas and electricity to tenants of the 6,000 remaining houses to be built in the Gorbals, and the general principle to be followed in other redevelopment areas, are to be given further consideration.

The Town Council of the little Ayrshire town of Stevenston has been told that it is itself largely to blame for the fact that there are now no facilities for the payment of gas accounts in Stevenston and that consumers have to go to Saltcoats for this purpose.

Gas centre closed

In reply to a protest from the Provost, the Manager of the Scottish Gas Board, Glasgow and Western Division, said that the service centre in Stevenston was closed because the amount of business conducted by the Gas Board in Stevenston both in the sale of appliances and in the collection of outstanding accounts, failed to justify the very considerable cost of maintaining premises there.

In the last several years this business, the letter added, had been decreasing largely through the present policy of the Council in demolishing houses equipped with gas and replacing them with houses not so equipped.

The letter mentioned the possibility of the provision of facilities for the paying of accounts by means of periodic visits of a mobile service centre.

A meeting is being arranged between the Manager and the Provost.

Speaking at another meeting in the city, Mr. Myer Galpern, Lord Provost of Glasgow, said that there may be a 'little bit of trouble' about the smokeless zone which is to come into operation in the centre of the city later this year.

The area affected by the proposals, he said, included industrial firms, commercial premises, and 367 dwelling-houses. It was expected that commercial and industrial concerns would raise few objections to the change-over, 'but there will have to be great deal of propaganda to get the average Glasgow housewife to do some really revolutionary thinking.'

There was still a feeling that the focal point in a room must be provided by a coal fire. Added to this were difficulties arising from the cost of the necessary adaptations.

Coke-burning fireplaces have been fitted in a typical two-room-and-a-kitchen house at 36, Osborne Street, Glasgow, to show the 366 householders in the area what will be expected of them when a smokeless zone is declared in the centre of Glasgow. Alternatively heating by gas and electricity is being demonstrated in the City Chambers.

WATER POLLUTION

The Water Pollution Research Laboratory will be holding its first open days on May 6 and 7, when the work of the laboratory will be on view to those interested in the treatment of sewage and industrial waste waters and the control of pollution of natural waters. Applications for invitations to visit the laboratories on one or other of these days should be sent to the Director (Elder Way, Stevenage, Herts.) not later than April 30.

Sir Hugh to address London conference

Sir Hugh Beaver will give a presidential address at the International Clean Air Conference in London in October. The conference, sponsored by the National Society for Clean Air, will include sessions on national air pollution situations, legislation, administration, research and public opinion and education. Visits and tours to industrial research and other establishments of air pollution interest will be made. A highlight of the conference will be a reception at Guildhall by invitation of the Lord Mayor and the Corporation of the City of London.

Education and Training for Gas Engineering

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ASSISTANT SECRETARY, THE INSTITUTION OF GAS ENGINEERS

THE gas industry is now facing tremendous competition from the electricity and oil industries, both of which have immense financial and technical resources at their disposal. But this should not be a cause for despondency or dismay; rather should it be a stimulus to greater endeavour. It is no new experience for the gas industry to be faced with severe challenge as anyone who cares to peruse the Transactions of the Institution of Gas Engineers over the last 90-odd years would discover. The industry has always, however, been quick to respond to and successfully encounter such a challenge. When one considers the programme for the last Autumn Research Meeting, the wide range and great variety of topics considered and above all the high level of discussion, one is bound to feel encouraged and optimistic. I doubt if there has ever been a time when so much has been going on, when so many fascinating problems are there to be tackled by enthusiastic young engineers and scientists.

This present era of rapid change and development therefore calls for modification of our existing scheme of education and training for gas engineering if it is to be adequate and appropriate for the gas engineers of the immediate future. This is a matter to which those responsible for education and training in the area gas boards and the Gas Education Committee of The Institution of Gas Engineers have given considerable thought during the last few years. As a result, a revision of the examination requirements for election to Corporate Membership of the Institution is to be introduced.

Before dealing with the details of these proposals it would, I feel, be useful to review the development of the education scheme of the Institution from its early beginnings not only because this development has been achieved as a result of much endeavour and effort on the part of very many people and for this reason is an interesting record, but also because it provides a good example of an education scheme which throughout the years has been modified and amended to meet the needs of an ever growing and changing industry.

The gas industry was one of the first to be associated with organised technical education on a national scale in this country. Examinations in gas manufacture were introduced by the Society of Arts (now the Royal Society of Arts) in 1874. The City and Guilds of London Institute for the Advancement of Technical Education was founded in 1878 and took over from the Society of Arts the work on technical subjects. Gas manufacture thus became one of the first subjects for which the City and Guilds of London Institute provided schemes of training and examination and it is acknowledged as one of its 'foundation subjects.' In those early days the term 'gas manufacture' appears to have been more embracing than current usage envisages and indeed it appears to have covered all aspects of gas engineering—manufacture, distribution and utilisation. The City and Guilds of London Institute has continued as an examining body in gas subjects since that time.

During the early years of the twentieth century an increasing interest in education matters appears to have developed and numerous references are to be found in the Transactions of the Institution. Thus in the Annual Report of the Council, 1903-04, mention is made of a special committee appointed by the Council of the Institution of Civil Engineers to report as to the best methods of training for all classes of engineers, including both scholastic and technical education. The Committee was instructed to maintain the principle that the education of an engineer must include both practical experience and scientific training. The Council of the Institution of Gas Engineers was invited to appoint a representative, and President, Mr. H. E. Jones, was nominated.

This committee worked extremely hard for some 2½ years and produced a report which makes very interesting reading even though published over 50 years ago. Time will not permit of my considering in any detail the recommendations made by this committee except to draw attention to the emphasis placed upon combining practical with theoretical training and to the suggestion that wherever possible a year's workshop training should be interposed between leaving school and attendance at

From a paper to the London and Southern Junior Gas Association, March 6, 1959.

a university or technical college. In this report was the germ of the idea of sandwich courses which now make a very important contribution to the training of engineers and technologists.

The Annual Report of the Council of The Institution of Gas Engineers, 1905-06, records that 'copies of its (the Committee's) valuable Report and recommendations duly adopted have been received.' Though no further references to this excellent Report are to be found in the Transactions of The Institution, there is little doubt that its findings considerably influenced the gas engineers of that time in drawing up programmes of study and training for their pupil engineers.

However, in the same Annual Report of the Council, 1905-06, its attention was drawn to the desirability of the Institution being invited to assist in the nomination of the examiner in the subject of gas manufacture under the City and Guilds of London Institute, Department of Technology. This was the beginning of the active co-operation between the City and Guilds of London Institute and The Institution of Gas Engineers which still persists and indeed plays an important part in the industry's programme of technical education and training.

Proposed Revision

At the Annual Meeting of The Institution of Gas Engineers in Dublin in 1907 a resolution was adopted by which, through co-operation between the Department of Technology and the Council of The Institution of Gas Engineers, and the employment of advisory or consultative methods, arrangements regarding such questions as the number of grades, the scope of the syllabuses, the duration of the course of instruction and the appointment of examiners would be mutually and satisfactorily agreed. The proposal was welcomed by the City and Guilds of London Institute and an Advisory Committee on Education of The Institution of Gas Engineers was formed which became the forerunner of the present Gas Education Committee of the Institution. This Committee wasted no time and very soon proposed a revision of the examination scheme on the basis of a division of the subject matter into two sections. The resolution of the Council was confirmed at the Annual General Meeting in Dublin.

The two branches became known as Gas Engineering and Gas Supply—a division which, with slight modification, has been continued until the present time. Further two grades, Ordinary and Higher, were established in each branch.

At the Annual General Meeting of the Institution held in June, 1912, three important papers were presented and discussed. The first was a report on the education and certification of gas fitters, prepared by a special committee of the Manchester District Institution of Gas Engineers and the other two comprised reviews of the examinations in gas engineering and in gas supply by the examiners in these subjects. No substantial amendment to the examinations in gas engineering and gas supply resulted from the latter papers, but the discussion is of considerable interest since it reveals the fact that the examiners and the gas engineers of nearly half a century ago were faced with very similar problems to those with which we still have to contend. Considerable stress was placed upon the necessity of differentiating between education and examination, it being pointed out that the examination is not an end in itself but only a means to an end. It would, I feel, be true to say that as the Institution's scheme of education and training has developed and particularly during the last decade attention to this aspect has been a dominating feature.

Again, during this interesting discussion the necessity of associating practical professional experience with the theoretical training required to pass the examination was emphasised. Since the Institution obtained its Royal Charter it has, of course, been necessary for an applicant to satisfy both of these requirements as well as other requirements relating to age and occupation in order to be elected an Associate Member.

The report on the education and certification of gas fitters represents an important milestone for two reasons. First, from it stemmed an approach in 1913 by the Institution to the City and Guilds of London Institute asking the Institute to consider the initiation of a scheme for the education, practical examination and certification of gas fitters. Looking through the Annual Report to the Council 1912-13 where correspondence between the Institution and the Institute is fully reported, one can glean that there must have been a considerable difference of opinion as to the examination of gas fitters. The City and Guilds insisted upon the introduction of a written paper as well as a practical test while many eminent gas engineers of that time considered it quite unrealistic to expect gas fitters successfully to attempt a written paper.

In the end the City and Guilds won the day and their examinations in gas fitting have ever since comprised both written and practical tests. In latter years the nature of the written papers has been considerably changed and they now comprise a comparatively large number of questions which can be simply answered. Although there are critics of this type of paper it has, I suggest, the very decided merit that it enables the examiners to test a candidate's knowledge over a wide coverage of the syllabus and does not unduly penalise the candidate who has difficulty in expressing his thoughts, a difficulty which is quite common in candidates of this type and one which is not altogether unexpected.

Interesting Development

The first examinations in gas fitting were held in 1915 when there were 257 candidates. The scheme was thus very successfully launched, and has never looked back. There are now over 2,000 candidates annually. The development of the scheme of training and examination of gas fitters is most interesting since it too represents an admirable example of the modification and adoption of a system of training to meet the demands of a changing industry. It is a little outside the scope of this paper and time precludes more than a passing reference, but those who are interested may readily trace this development from the reports of the Gas Education Committee in the Transactions of the Institution, and it has been summarised elsewhere. Apart from the initiation of a national scheme on the proposal of the Institution, the Gas Education Committee for many years acted as the Advisory Committee on this subject for the City and Guilds, a situation which continued until the major revision of the education scheme in

1948 to which I will refer later. Since that time other committees have been responsible for the administration of the examinations in gas fitting, but the Institution has always been represented on them. It is important that this should be so since it is an accepted principle of the education and training schemes of the gas industry that it should be possible for a student to start as an apprenticed artisan and progress through the various stages to professional status as a chartered gas engineer.

This progression is probably more difficult to achieve at the present time than formerly. The segregation of children at an early age into different types of school or into different streams in the large comprehensive schools, combined with the increasing standards required by professional institutions, makes progression of this nature the exception rather than the rule. On the other hand opportunities for further education are now very much greater than ever before, and all area gas boards have training and education officers who are highly skilled in detecting latent talent. Moreover, they have the means and desire to encourage the development of this talent. It is therefore necessary to ensure that the avenues whereby such encouragement may be effected are not closed.

Golden Jubilee

In January 1909 the first batch of apprentices of the Gas Light and Coke Company attended classes at the Westminster Technical Institute. This, I understand, represented the first properly co-ordinated scheme of apprenticeship arranged by private industry in collaboration with a technical college. The Gas Light and Coke Company and its successor, the North Thames Gas Board, have ever been pioneers in matters concerning education and training. Apart from the development of their own schemes of training they have always been staunch supporters of the Institution and of the City and Guilds of London Institute. If it would not seem presumptuous I should like to congratulate the Board on the Golden Jubilee of its apprenticeship scheme, and at the same time to acknowledge with gratitude the assistance which the Institution, and I personally, have received from its officers in connection with educational activities.

Returning to the Report on the Certification of Gas Fitters, there is the second reason for its importance in the development of technical education in the gas industry. During the course of the discussion the President, Mr. R. G. Shadbolt, read a letter from the Joint Council of the English Junior Gas Associations in which the following suggestion was made, that ' in the carrying out of the scheme for the training and examination of gas-fitters, the local district Junior Gas Associations be invited to appoint a representative to serve on the local administrative committees.'

When later the Institution's own educational scheme developed, the Junior Gas Associations made and still continue to make an important contribution to the work of the District Gas Education Committees. Further they are now represented on the main Committee by a member nominated by the British Junior Gas Associations Joint Council. How abundantly have the Juniors justified their desire to be closely associated with the educational work of the Institution.

While it was acknowledged that the examinations of the City and Guilds of London Institute satisfied an important demand it is apparent from a perusal of the Transactions of the Institution that prior to the 1914-18 war several members of the Institution were feeling that courses of a more advanced nature were necessary for the gas engineers of that period and in 1916 a Committee was appointed on the advice of the City and Guilds of London Institute primarily to revise the syllabuses for the gas supply examinations. Little was done during the war years, but in 1920 the Committee was resuscitated, strengthened in membership and given wider terms of reference. A sub-committee was appointed to consider in detail a revision of methods of education and examinations.

As a result of the work of the Committee and its sub-committee a special meeting of the Institution was held at the Institution of Mechanical Engineers on February 14, 1923, for the purpose of submitting for approval the ' Scheme for the education and certification of those engaged on the technical work of the gas industry and for making arrangements for giving effect to it.'

The Council's proposals being accepted by the members at the special meeting the Institution's education scheme was initiated. It was an ambitious scheme, bearing in mind the time at which it was launched and represented a marked raising of the standards required of those aspiring to become professional engineers and I expect its introduction was the cause of some heartache on the part of the students of that time just as has been every major revision of the scheme since its inception, although I have no evidence to offer in support of such an assertion.

The scheme provided for three grades of examinations, the ordinary, higher and diploma grades, and comprised examinations in gas manufacture or gas supply, together with appropriate ancillary subjects. Close collaboration was established with the Board of Education (now the Ministry of Education), the Scottish Education Department and the local technical colleges at many of which courses for the various grades were initiated.

Committees of Advice

The scheme was administered by the Gas Education Advisory Committee and there were Committees of Advice for Scottish Students and for Welsh Students. The term ' Advisory ' was soon omitted from the title of the main Committee which has continued to the present time to be responsible to the Council for the educational activities of the Institution.

In its Report of 1927-28, reference is made to three important developments. The first concerned the setting up of the district gas education committees, the membership of which comprised representatives nominated by the appropriate district associations and those nominated by the junior gas associations together with a representative nominated by the Board of Education or the Scottish Education Department. These committees during the last 30 years have made substantial contributions to technical education in the gas industry, the importance of which should not be forgotten.

As a result of the implementation of Section 4 of the Gas Act, 1948, much of the work the district gas

education committees used to do is now more appropriately undertaken by the education and training officers of the area gas boards and some of the district committees have during recent years felt that perhaps their term of useful service was coming to an end. It is difficult to generalise on this subject since the extent to which the area gas boards make use of the district committees in connection with their statutory educational duties varies considerably. Some use the committees as advisory committees on education and training, some refer specific problems to the committees while others make very little use of them. The problem was thoroughly reviewed in 1951 and as a consequence the constitution and duties of the district gas education committees were revised. It may perhaps be that the situation has changed since that time, but unless it is quite certain that the district gas education committees can no longer serve the Institution and the industry, it would I feel be a retrograde step to disband them. I personally am of the opinion that there are many ways in which they can continue to do useful work and I would like to pay tribute to their excellent service for well over a quarter of a century.

Firmly Established

The second point related to the acceptance by the Institution of the principle that possession of the higher grade certificate and the diploma should go a long way towards securing the holder admission to membership of the Institution. As time has progressed this principle has become firmly established and it is now not possible, and has not been since 1937, for a candidate to be elected to associate membership who is not in possession of the requisite examination qualifications.

The third matter reported was the holding of the first short course for teachers by the Board of Education. Until quite recently, and even to a large extent today, the teaching of specialist subjects like gas engineering, gas supply and gas fitting, has of necessity been undertaken on a part-time basis by members of the staffs of gas undertakings, many of whom although expert in their subject are not well acquainted with teaching techniques. The value to the gas industry of these short courses for teachers which, with the exception of the war years, the Board and now the Ministry of Education have conducted almost annually since 1927 is inestimable. I have never heard anything but praise and gratitude from those who have been able to attend them. Their success stems largely from the personalities of the H.M.I's. who have acted as directors of the courses. First there was Mr. C. H. Creasey who was followed by Dr. P. C. L. Thorne who, in turn, was followed by Mr. F. Caunce. The gas industry has indeed been fortunate to have had the service of these gentlemen.

Returning now to the development of the Institution's scheme it may be said that the broad structure remained unaltered for some 25 years but there were changes from time to time, mainly in connection with the standards of ancillary subjects. In the 1930's due probably to increasing competition from electricity there were marked advances in the fields of domestic and industrial utilisation and increasing emphasis came to be placed on the need for technically trained men to be available for district work. Originally, the standard of ancillary subjects for the higher grade certificate in supply was lower than that for manufacture, although not markedly so, and there was some resistance to the admission to corporate membership of those engaged as district representatives even though they may have passed the Higher Grade Certificate in Supply. There was clearly a need for a revision of the education regulations to raise the standards of ancillary subjects required of those engaged in district work to that of those employed at the works. Accordingly in 1937 the Higher Grade Certificate in Engineering was renamed the Higher Grade Certificate in Gas Engineering (Manufacture) and the Higher Grade Certificate in Gas Engineering (Supply) was introduced which was of comparable standard. The former Higher Grade Certificate in Gas Supply was continued as the Certificate in Gas Supply primarily for students not engaged on the practical side of the gas industry.

Those who possessed either the Higher Grade Certificate in Gas Supply or its successor could convert it to the Higher Grade Certificate in Gas Engineering (Supply) by taking the additional ancillary subjects. Further in 1937 there was a revision of the by-laws in which, among other things, cognisance was taken of the parity in the examination requirements of engineers at the works and those on the district for the purposes of election to corporate membership of the Institution.

Very shortly after this revision, which was of a minor character, consideration was given to a major revision of the Education Regulations whereby an associate membership examination, comparable in standard and status with the examinations of other engineering institutions, notably the Civils, Mechanicals and Electricals, could be initiated. Immediate action in this connection was prevented by the outbreak of war in 1939, but in July, 1942, a sub-committee was appointed for the purpose of drafting a scheme which could be put into operation in the post-war period. Discussions were held with other institutions and in particular the Institution of Civil Engineers as a result of which the associate membership examination as it now exists was proposed.

Alternative Essential

The sub-committee realised early in its deliberations that the introduction of an examination of the type envisaged would involve the cessation of two grades at examination in gas engineering. Experience over the years had shown that there were many students who progressed to the Ordinary Grade level but did not proceed beyond that stage, and it was felt essential to provide some alternative for such candidates. At the same time it was considered desirable to divorce this alternative from the professional examination of the Institution, and the City and Guilds of London Institute was accordingly invited to conduct examinations in gas technology (manufacture) or (supply). The Institute accepted this proposal and suggested that it would also be appropriate to review the examinations in gas fitting to provide for intermediate and final examinations in place of the existing three grades. In order to fit into the administrative arrangements of the Institute it was agreed that these examinations should be admini-

stered by advisory committees analogous in composition to that of other advisory committees for the many other subjects dealt with by the Institute and providing for representation of the education authorities, the professional institutions and the industries concerned.

In the event, the sub-committee was able to progress more rapidly with these proposals than with those for the associate membership examination. The new or revised examinations of the City and Guilds of London Institute were introduced in 1946, whereas the Education Regulations introducing the associate membership examination (I.G.E. Communication 330) were not published until 1948, the first examinations to be conducted under them being available in 1951. As a result of the discussions with the Institution of Civil Engineers it was arranged that the new associate membership examination would comprise the Common Preliminary Examination of the Engineering Joint Examination Board, the Joint Section 'A' Examination of the Institutions of Civil and Electrical Engineers and the Joint Section 'B' Group VIII Examination conducted by the Institutions of Civil and Gas Engineers.

An accepted method of study for the examinations of the professional engineering institutions is by means of national certificate schemes conducted at technical colleges and administered by a joint committee of the Ministry of Education or Scottish Education Department and the professional institution concerned. The Institution of Gas Engineers consulted the Ministry in regard to the setting up of national certificate courses in gas engineering, but the Ministry felt that the total number of candidates coming forward annually and the limited number of colleges at which it would be possible to support the courses did not warrant the initiation of a separate administrative committee, and proposed that there should be higher national certificates in civil and gas engineering administered by the Joint Committee of the Institution of Civil Engineers and the Ministry of Education. A similar committee exists for Scotland. The Institution is represented on these committees and certificates awarded to successful candidates are countersigned by the Presidents of both Institutions as well as by the Under-Secretary of the Ministry and the Principal of the technical college.

Considerable Exemption

Courses for such certificates are possible only in a limited number of the larger cities, but the curriculum of the associate membership examination is such that a very considerable measure of exemption can be afforded to students who possess a Higher National Certificate in mechanical engineering, and this indeed is the method whereby many candidates have studied.

The initiation of the associate membership examination was a major revision and it was to be expected that its introduction would be the cause of considerable controversy as, in fact, was the case. There were many who deprecated the close link with the Institution of Civil Engineers and others who considered that it would have been more appropriate to have a similar arrangement with the Institution of Mechanical Engineers. This view was particularly prevalent in the North of England and in Scotland where there is much greater provision for mechanical engineering than for civil engineering.

It would, I think, be agreed that the curriculum eventually agreed as a result of the compromise necessary to work closely with another Institution was not completely ideal and differs from a curriculum which might be prepared from scratch having in mind only the needs of gas engineers specialising in manufacture or supply. The advantages accruing from such an arrangement are, however, considerable, and in my view greatly outweigh the disadvantages of compromise.

It was essential in the post-war years for chartered gas engineers' to be accepted on a par with other 'chartered engineers' not only by the gas industry but by Government departments and other authorities. There had been a number of instances during the war and prior to it when this parity had definitely not been accepted and the Institution was on unsure ground when endeavouring to combat these decisions, because its examination requirements were obviously lower than those of the other major engineering institutions. Since the introduction of the associate membership examination the Institution has been able on a number of occasions to obtain official recognition of this parity and there is no doubt in my mind that the status of the chartered gas engineer has been very much enhanced as a result of the 1948 revision of the Education Regulations.

Important Aspect

Another aspect which I regard as important, is that study for the associate membership examination whether internally by national certificates or externally for the examination itself, enables a student substantially to cover the examination requirements of other institutions. This situation has become even more favourable since the initiation of the scheme for there is now a common Part I Examination for a number of institutions (Civil, Mechanical, Electrical, Municipal, Marine, Production and Gas).

I have for several years thought it desirable, and there are many who concur with the view, that every qualified engineer and technologist employed in the gas industry should belong to two institutions. First, since it is the province of The Institution of Gas Engineers to provide a national platform for the discussion of technical subjects of special interest to the gas industry and to act as the liaison in such matters internationally he should, in my opinion, be a member of this Institution. I use the term 'gas industry' here in the sense in which it is defined in By-law 1 of the Institution's by-laws.

In addition, the engineer and technologist employed in the gas industry could with advantage belong to one of the larger institutions such as the Institutions of Civil, Mechanical, Electrical or Chemical Engineers, the Royal Institute of Chemistry or the Institute of Physics, according to the nature of his employment or interest. It is acknowledged that by reason of their wide spheres of interest the number of opportunities when these larger institutions are able to provide a platform for the discussion of subjects of particular interest to gas engineers is limited. Membership of such an institution will however help to keep the engineer or technologist informed of the developments in a broad field.

The introduction of the associate membership examination has considerably facilitated this procedure so far as examination requirements are concerned. There are, of course, other requirements relating to practical train-

ing and professional experience in connection with which each institution has its own ideas. It is important that young student apprentices and pupils, who have in mind ultimately to qualify for more than one institution, should ascertain at the outset what conditions they will have to fulfil in respect of each institution in which they are interested. I know from my contacts with the education and training officers of the boards that they have this very important aspect very much in mind.

This question of multiple membership of professional institutions is one which has recently been considered by the Advisory Council on Scientific Policy under the chairmanship of Professor Sir Alexander Todd.

Like other institutions, The Institution of Gas Engineers is not in possession of complete data in this regard but we made an analysis of the information concerning 1925 corporate members in respect of whom we had the necessary details and found that 536 belong to one more institution, 113 to two other institutions and 13 to three other institutions. The other institutions include Civils, Mechanicals, Elecricals, Structurals, Chemicals, Production Engineers and the Institutes of Fuel, Chemistry and Physics. These figures indicate that multiple membership so far as gas engineers are concerned is about 27-28% compared with about 16% for all institutions.

Methods of Study

I have now arrived in my review of the development of the Institution's examination at the conditions under which it is now conducted and it would be appropriate to consider the methods of study that are available. Before doing so, however, I would like to go back to the immediate post-war years to refer to the intensive courses in gas engineering which were conducted at several technical colleges under the Government's Further Education and Training Scheme for the rehabilitation of those returning from service with H.M. Forces or other forms of national service. So far as the gas industry was concerned the Institution took the initiative and with the willing co-operation of the Ministries of Labour and National Service and of Education, technical colleges and gas undertakings arranged a number of full-time courses of approximately six months' duration at technical colleges. Those students whose studies had not advanced very far before they were interrupted took two such courses. The first prepared them for the Ordinary Grade Certificate in gas engineering (manufacture) or (supply) and was followed by approximately six months practical training with a gas undertaking, not necessarily the one by which they were employed before 'call up' for the services. Finally, the second full-time course at the college prepared them for the Higher Grade Certificate. Some students were able to complete their studies with one such six-monthly course and some practical training.

The organisation and conduct of these courses involved a very great deal of work and effort on the part of many people. Some of it, particularly on the administrative side, fell to the Institution but by far the greatest contribution was made by the teachers in the specialist subjects and the members of the Board of Examiners. They were almost without exception men, drawn from gas undertakings, who had been helping to keep the gas industry going under war conditions and were themselves tired and war weary. They might well have been excused had they endeavoured to shun this additional burden but the enthusiasm with which they set about the work was quite remarkable. Nor must we forget the students themselves. The change from conditions in the Forces to those of full-time study at a college and life, for many of them, in lodgings, imposed a severe mental strain. It would not have been at all surprising had many of them fallen by the way. In fact very few indeed did so and most of them were inspired with a sense of urgency and earnestness which was extremely rewarding to those who had anything to do with the conduct of the courses. Time does not permit of my giving greater detail of this effort but it has been referred to in the reports of the Gas Education Committee, which are worthy of consultation from time to time for they relate to one of the finest endeavours in the educational field with which the Institution has been associated.

These courses were largely financed by the Government but their undoubted success led the Gas Education Committee in 1948 to make enquiries as to the possibility of conducting further courses of this kind at the expense of the industry. Conditions at that time were however not appropriate for such a development and it was not until some years later that sandwich courses which are very similar in nature to the intensive courses, were adopted by the gas industry.

Perhaps I may now return to the methods whereby young engineers and technologists may qualify for Associate Membership of the Institution. I am here concerned only with the examination requirements. There are other requirements relating to age, practical training and the holding of a technical position in the gas industry which apply in any case. Briefly the examination requirements may be satisfied by appropriate university degrees, successful attendance at approved sandwich courses in gas engineering, higher national certificates and of course, the associate membership examination itself.

University degrees. So far as university degrees are concerned, the Institution accepts a bachelor's degree of a British or approved Commonwealth university in the post matriculation course for which in the opinion of the Council of the Institution a competent standard of knowledge has been attained in at least two of the following subjects: Mathematics, physics, chemistry, engineering, metallurgy.

Source of Criticism

This regulation is sufficiently wide in scope to cover practically all university graduates in science or engineering employed in a technical capacity in the gas industry. This fact has in the past been the source of some criticism on the ground that entry to corporate membership of the Institution is much too easy for the university graduates. It is considered however that the graduate in science or engineering has received the requisite basic technical education and has generally acquired the ability to apply it in the surroundings in which he finds himself so that by the time he has been in the gas industry sufficiently long to satisfy the requirements of the by-laws in regard to practical training and the holding of a technical position he will have become eminently suitable for cor-

porate membership. There may be exceptions to this as indeed there must be to every generalization of this nature but by and large the exemption from further examinations accorded to university graduates has been justified by experience.

Sandwich courses. The sandwich course principle of training is not new and it has in certain technologies been in operation for very many years but the development of sandwich courses in the post war years has been disproportionately greater both in the number of courses and kinds of technology for which they make provision. The attitudes of industry generally and of government, both central and local, have been largely responsible for this development. It is also closely connected with the acute shortage of technical personnel in the post-war years.

In February, 1956, the Minister of Education and the Secretary of State for Scotland presented to parliament a White Paper on Technical Education, in an appendix to which some information is given on the numbers of engineers being trained in the U.S.A., the Soviet Union and Western Europe. Direct comparison of the numbers of engineers and technologists trained in the different countries is difficult, since the systems of education and of employment of technical manpower vary considerably between the different countries. Nevertheless, by making certain generalisations and endeavouring to equate approximately similar categories of personnel it is found that in Great Britain with a population of 50 mill. there were produced in 1954, 2,800 university graduates in the engineering and other applied science faculties. This is equivalent to 57 per mill. of the population. In addition, 8,100 passed Higher National Certificates equal to 164 per mill. of population. Rather less than one half of these eventually became qualified 'chartered engineers,' while the remainder must be regarded as high grade technicians.

In the U.S.A. in the same year 22,000 engineering graduates were produced, equal to 136 per mill. population. This figure is expected to rise to 43,000 by 1964. In addition there are some three to five trained 'engineering aides' in support of every professional engineer. The Americans like ourselves are anxious to increase the output of both technologists and technicians, but are faced with a very serious shortage of science teachers in the schools.

Greater Rate

In Russia, it is claimed that 60,000 'professional engineers' or 280 per mill. of the population, and 70,000 engineers of lower grade—326 per mill. of population—are being trained annually. These figures are approximate only, but they are substantially confirmed by a report of a team of British engineers who visited Russia in the autumn of 1956. Even when allowances are made for the differences in the standards of training in the various countries it is clear that Russia and America are producing engineers and technologists at a much greater relative rate than we are.

It is encouraging to notice that the Government and industry are now fully alive to this position and considerable effort is being made to provide facilities for a greatly increased production of trained and qualified engineers and scientists. First, the Government and industry are devoting very substantial sums of money to enlarging the universities and to enabling them to acquire modern equipment which is complex and extremely costly. Further, there has in recent years been a considerable uplifting of the salaries paid to professors, teachers and lecturers at universities which while not still competitive with those paid by industry are nevertheless attractive and recruitment of staff is not the problem it was.

Considerable Extensions

Even with these developments it will be impossible for the universities to satisfy the need and a second feature of great consequence is the reorganisation of the work of the technical colleges. Very considerable extensions are being made to these and many of them are acquiring magnificent new buildings equipped with the most up-to-date apparatus and plant. A number of them have been upgraded and will be concerned only with advanced technology and research, the more elementary work with which they were formerly concerned and which accounted for a very considerable proportion of their effort, being passed to the technical colleges. Several of these upgraded colleges are closely associated with universities and will be able to provide courses for university degrees as well as national, diploma and sandwich courses, leading to membership of one of the chartered professional institutions. The New Diploma in Technology which has arisen as a result of the work of the National Advisory Council for Technological Education—the Hives Committee—is of especial significance in this connection. A newly founded and distinguished body called the National Council for Technological Awards under the chairmanship of Lord Hives, is responsible for the administration of the Diploma in Technology which, while quite different in character, is broadly equivalent to a university honours degree. The Council before considering the award of the Diploma in Technology to successful students requires to approve the college, its equipment and staff and the content of the courses leading to the award. It very wisely insists upon a course which is not entirely confined to technical studies but includes a fair measure of liberal studies of wide coverage.

Sandwich courses which include in each year periods of full-time training at the technical college and periods of works training in industry, are found to constitute an appropriate means of qualifying for the Hives Award. The National Council for Technological Awards has recently published a memorandum entitled 'An award higher than the Diploma in Technology.' In it are given details of an award which may well come to be regarded as having considerable merit and one which is likely to satisfy an outstanding need.

Some idea of the growth of sandwich courses during the last few years may be gleaned from the Report of the Ministry of Education entitled 'Education in 1957' (H.M.S.O. Commd. 454), in which it is stated that at the time of publication of the White Paper there were about 100 courses of this kind. In July, 1957, a list of approved courses numbering 203 was published and the corresponding list for 1958 contains well over 250. The number of students enrolled in sandwich courses in 1956-57 was 3,979, compared with 2,327 in 1955-56 and 1,419 in 1954-55. So far as the gas industry is concerned courses were started in 1954 at the Royal Tech-

nical College, Salford, and the Enfield Technical College.

The course at Salford was the first course designed especially for the gas industry and became possible largely through the initiative of the North Western Gas Board and particularly its education officer. The course at Enfield was initially intended for civil engineers and is indeed a sandwich course in civil engineering but arrangements are made for students who so desire to study gas engineering in the final years. These courses have been followed by sandwich courses at the College of Technology, Birmingham, and the Westminster Technical College. Further, a full-time course in civil engineering for gas engineers leading to the Associateship of the College has recently been commenced at the Heriot-Watt College, Edinburgh.

The successful completion of one of these courses entitles a student to complete exemption from the associate membership examination, the final college examinations being subject to assessment by external assessors nominated by The Institution of Gas Engineers. The progress of these courses has been reported in the 31st-35th Reports of the Gas Education Committee. Sandwich courses are likely to provide one of the principal means of training for gas engineering and will, I confidently anticipate, provide the gas industry with some fine young engineers.

Confused Thought

There has in the past been a good deal of confused thinking about sandwich courses and for that matter about the work of technical colleges generally. This, I feel, has largely arisen from an endeavour to make direct comparison between the work of universities and technical colleges. It is true that their work is frequently complementary and it is possible to study for university degrees at some technical colleges, but in general I feel they provide for the needs of different types of student. They do, in fact, represent different routes for arriving at the same end product. The fundamental principle and advantage of sandwich courses is that they integrate full-time education within the overall period of industrial training. This type of approach admirably suits some students who will do extremely well in a sandwich course but would not be so happy with the more academic university approach. The point I wish to make is that I have so far considered two methods of studying for gas engineering which the Institution has recognised as appropriate for its examination requirements for associate membership and I would not like to say categorically that the one is better than the other. For certain types of work the university trained man would probably be more suited, while for others the sandwich course might well produce a more appropriately trained technologist.

Maximum Exemption

National certificate courses have been the means whereby the majority of students have so far studied for the associate membership examination. These courses may be two types, one based upon evening study only and the other upon part-time day and evening study. The Institution of Gas Engineers has always granted to the holders of Higher National certificates exemption on a subject for subject basis and for this reason it is desirable for a student if at all possible to attend a course leading to a Higher National certificate in civil and gas engineering, for he will then obtain the maximum exemption and will have to take only the one paper in either gas engineering (manufacture) or (supply) which is required of all higher national certificate candidates. Unhappily, because of the geographical distribution of students it has not been possible to support courses for these certificates except in a few of the larger cities and many students have had instead to take a Higher National certificate in mechanical engineering. While this is an excellent qualification per se it does leave the student with a few subjects to take in order to qualify for associate membership of the Institution of Gas Engineers. These are generally applied chemistry and the main subject gas engineering (manufacture) or (supply). Suitable, if not entirely appropriate courses in applied chemistry are usually available locally but the main subject has presented a distinct problem. In the North of England the difficulty was met by the appointment by the Northern Gas Board of a tutor who regularly visits a number of centres where the students may be assembled. He is assisted by specialist lecturers from time to time, but the bulk of the work has fallen on him and it must at times prove quite an onerous commitment. He has had a considerable measure of success due without doubt to his enthusiasm and ability.

Another solution was found by the provision of a full-time post National Certificate course at the College of Technology, Birmingham, which enables students possessing a Higher National certificate in mechanical engineering to complete the necessary outstanding subjects by full-time attendance at the college for one year. A similar course is offered by the Enfield Technical College.

Membership Decreasing

It might be interesting to see, over the years, the routes by which gas engineers have become members of the Institution. Appendix 1A of the paper gave an analysis of the membership of the Institution since 1920. There was a marked increase in membership in the years following the war but this has now slowed down and the total membership has increased only slightly during the last three years. One feature which I think is a little disturbing is that while associate membership is increasing, membership is decreasing. This is because the loss through resignation or death of members is not being made good by transference from associate membership to membership of many who are qualified to transfer. There are three reasons for this. First there is the economic reason; the subscription for membership is higher than that for associate membership. This situation may perhaps be eased a little by the income tax concession recently afforded by the Government in respect of subscriptions to professional and learned societies. The second is due to an assertion by certain associate members that it is better to be an associate member than a member for there is no 'back door' to associate membership while By-law 13 B (2) provides such a form of entry to membership. Figures quoted in appendix 1B of the paper should dispel this illusion. The number of members so admit-

ted is relatively small and there has been a considerable tightening up by the Council during recent years. The third reason is sheer inertia.

Reference has already been made to a pending revision of the associate membership examination. During the course of reorganisation of the gas industry which has followed nationalisation the technical work has become largely functionalised into three main branches: Production, distribution and utilisation, for each of which specially trained technical personnel are becoming more and more necessary. The Council and the Gas Education Committee have for some years had in mind the necessity of revising the examination in gas engineering (supply) so that provision might be made for specialisation either in distribution or in utilisation. Accordingly on January 11, 1956, an ad hoc sub-committee on syllabuses was appointed by the Gas Education Committee under the chairmanship of Dr. A. E. Haffner with the following terms of reference:

(i) To consider whether the curricula for the Certificates in Gas Technology (Manufacture) and (Supply) of the City and Guilds of London Institute are appropriate to present day needs and the trends of development in the gas industry and to make recommendations relating thereto.

Major Revision

(ii) To consider a revision of the syllabus in gas engineering (supply) of the associate membership examination in the light of present trends in the functional organisation of the gas industry and to make recommendations relating thereto.

Three years may seem a long ime for the Sub-Committee to have been working on this revision but it has been extremely thorough and has been at some pains to obtain the views of area gas boards, district gas education committees and technical colleges, as it has progressed with its deliberations. So far as the examinations of the City and Guilds of London Institute in gas technology are concerned the Sub-Committee early came to the conclusion that a major revision of the examination is now called for and felt that this would more appropriately be a task for the Advisory Committee of the City and Guilds.

Accordingly, on its proposal, it was agreed that this aspect of the Sub-Committee's remit should be considered by that Committee. The problems associated with these examinations are much less clearly defined than those connected with the associate membership examination. The history of the examinations indicates that they have not attracted the categories of personnel for whom they were designed, and it is apparent to the Advisory Committee of the City and Guilds that a complete overhaul of the scheme will be required. The Committee and a syllabus sub-committee it has appointed are still working on this.

With regard to the associate membership examination the Sub-Committee was left in no doubt as a result of its enquiries that provision for specialisation in one of the three functions—production, distribution and utilisation—is desirable, but it was unanimous in its view that specialisation at too early a stage is not in the best interests of the students or the industry. Accordingly it is proposed that there shall be in the second part of the associate membership examination two papers in general gas engineering which will be concerned with the basic fundamental principles of production, distribution and utilisation of two gases. These will replace the existing alternatives of gas engineering (manufacture) and gas engineering (supply). Two specialist papers in either production, distribution or utilisation will form a separate part of the associate membership examination.

A recommendation has been made which has been approved by the Council and which it is hoped to submit to the members of the Institution for approval at the next Annual General Meeting that a new class of 'graduates' be introduced. This will fill an unfortunate gap in the present membership structure of the Institution. The examination standard proposed by the Sub-Committee for 'graduateship' would be satisfied by the first two parts of the associate membership examination. For election to associate membership it would be necessary to take the additional part dealing with the specialist aspect. It is proposed that this revision shall become operative in October, 1962, so that candidates who have already embarked on a course under the existing regulations will have reasonable time to complete their examinations under those regulations.

The proposals of the ad hoc Sub-Committee are in line with the requirements of other institutions which, almost without exception, grant graduate membership upon the successful completion of a three-year sandwich course commencing at the Ordinary National certificate level.

In appendix 3A of the paper the examinations of the major engineering institutions were compared with the proposed revised associate membership examination of the Institution of Gas Engineers. In appendix 3B of the paper a comparison is made of the requirements for student membership, graduate membership and associate membership of a number of professional institutions. A study of these two appendices will lead to a better appreciation that the proposed revision of the associate membership examination and of conditions and classes of membership will bring the Institution more closely into line with the other engineering institutions. It will also provide the means of supplying the gas industry with the highly qualified specialist engineers which its present state of development demands.

DISCUSSION

Mr. C. H. Purkis, the President, opening the discussion, said that with certain exceptions the main emphasis of the paper was on the progress of educational schemes for the chartered engineer. Since this had meant a progressively rising standard culminating in the latest revision of the regulations for the associate membership examination he asked Mr. Higgins whether he thought that sufficient emphasis was placed on the more junior technician who had perhaps little hope of becoming a fully qualified member of the Institution.

In the years immediately after the war the intake of associate members by way of the Higher Grade certificate had been at its peak, but it seemed to be a real loss to the industry that there was no corresponding intake at the present time. A select few might be forging even further ahead but the full technological certificate of the City and Guilds Institute has never

ally 'caught on' and this left a serious gap between the fully qualified engineers and their assistants.

Second only to the need for adequate teaching staff was the necessity for adequate text books and works of reference. Indeed this need might be paramount in those areas where for geographical reasons a student had to do most of his private study at home. Mr. Higgins would no doubt agree that there was a serious shortage of such books, particularly on the supply side of the industry. Those privileged to work at, or in close touch with Watson House had access to technical reports and bulletin supplements but these might not be available to the average student. The Industrial Gas Development Committee put out a mass of well prepared information but even this might not be available to junior people. In most courses of instruction, therefore, a series of standard text books was quite basic to the whole system.

In view of his own three years' service on the Institution's board of examiners, he asked whether this examining body was really ideally constituted. It was essentially a group of specialists and Mr. Higgins might feel that the proposed change in the examination syllabus with general parts 1 and 2 and a specialist part 3 called for a corresponding change in its constitution and functioning, since it might well have to assess those students who entered by another route than a sandwich course.

Rôle of Juniors

He asked Mr. Higgins what role he envisaged for the Junior Gas Associations in the future development of education in the gas industry. In the London area at least there was little that could be done through the District Education Committee, but perhaps Mr. Higgins could indicate some of the ways and particularly those which affect the juniors, by which they could continue to do useful work. Apart from the District Education Committee, membership of the Junior Associations was open to *bona fide* students but the numbers applying for membership was small and their appearances unfortunately infrequent. Evening classes or home work which took up the bulk of their spare time might be the reason but thanks to the technical Press a report of most if not all of their meetings was published in the technical journals, and eventually all papers appeared in full in the Transactions of the British Junior Gas Associations. The technical information which emanates from their association was thus made freely available to all.

He went on; 'would Mr. Higgins think that the requirements for membership of our Association are too exacting? We are, of course, a technical body but we accept an Ordinary National certificate or its equivalent as the basis of Associate Membership and we feel that this is a reasonable basis for entry into a junior professional association.

Mr. R. N. Le Fevre, Training and Education Officer, North Thames Gas Board, asked whether this long course of study was really necessary; in fact, whether gas engineers—as known in the past—were really necessary at all. There were some who believed that the gas industry needed primarily chemical engineers and civil engineers, with structural, mechanical, electrical and other specialist engineers to perform the ancillary functions.

Perhaps even these could be dispensed with, for, if the overseas transport of methane proved an economical proposition, the most useful qualification for the gas industry of the future might well be a Master Mariner's certificate coupled with membership of the Institution of Refrigeration.

Should the gas industry of the future decide to dispense with gas engineers and instead to recruit only graduates or those professionally qualified as civil, mechanical, chemical and electrical engineers, it obviously would not be long before these engineers with different qualifications and backgrounds decided they were all working to a common purpose and must have a common meeting ground. They would then form an Institute of Gas Technology or Institution of Gas Engineers, and the industry would be back where it was today.

Mr. Higgins had pinpointed a most significant fact in advocating the desirability of multiple membership of professional institutions. On the sandwich course conducted at Westminster, the majority of students were working concurrently for both the Institutions of Civil and Gas Engineers and were in fact student members of both Institutions.

Mr. Higgins had omitted to say that the Institution's examinations were undoubtedly among the most carefully and accurately set and marked of any professional organisation. The board of examiners was a live, well-qualified body kept up-to-date by triennial appointment. It worked extremely hard for no reward other than the satisfaction of upholding the prestige of their profession; he wished that students could be made to realise that the examiners were on their side. There were never any 'catches' and endless trouble was taken in the framing of questions to avoid any possible ambiguity.

The Golden Jubilee of his Board's apprenticeship scheme was certainly an event to be proud of and much of the success of the scheme over the past 50 years had been due to the help so readily given by the Gas Education Committee. It had been the intention of the founders of the scheme—and it continued to be the Board's practice today—that there should be no limit to the progress open to the apprentice who merits it. Many had graduated as gas engineers and several had attained positions of eminence.

Too Modest

Mr. Higgins was too modest, since he had omitted to mention that the Sales Training scheme was conceived and nurtured by the Institution, and that the Management course at Brooklands was born of the Institution, only to be adopted by the Gas Council when it had grown to be a healthy well-developed child. Finally there was the Institution's Register of Teachers which did valuable work in keeping teachers of gas subjects up-to-date with all relevant technical information.

Dr. F. J. Eaton, Watson House, said that an interest had been taken in training at Watson House, where the laboratory staff had been increased from 87 to 150 persons. Naturally, a lot of them were young and were qualifying themselves in their jobs, but if they

had an 'O' level certificate it was difficult for them to go to the 'A' level because of the lack of training facilities. The same principle applied to those students who go from 'A' level to a degree, although the latter was possible by obtaining leave. He said that a graduate apprenticeship scheme would have a good chance of attracting the right type of person into the industry.

Mr. G. H. Kenyon, South Eastern Gas Board, said that Mr. Higgins had given a comprehensive historical review of the subject and an indication of the shape of things to come. To look back occasionally was a good thing, not only to see the achievements over the years, but also to get current developments in perspective. He, himself, could not be critical of the future proposals for training because he had been directly concerned with their preparation.

The birth of the present associate membership examination had stemmed from some rebels on the board of examiners, of whom he was one, and time had proved how right it had been. Clearly the current revision was in line with what the industry requires to-day in the way of professional qualifications. It was also in line, as the author had indicated, with developments in kindred institutions.

Referring to the City and Guilds examinations in gas technology, the conclusion had been reached that the Supply examination should be separated into Distribution and Utilisation. The Advisory Committee had approved a new framework and relative standards for examinations and the syllabus sub-committee was now getting down to detail. It was interesting to note, however, that, while the standard of the Associate Membership examination was rising, it was considered necessary to lower the standards of the City and Guilds Examinations, particularly in Manufacture and Distribution.

Analyses of the entries for the examinations in recent years and considerations for the future based on the concentration of manufacture into large works and integration generally pointed the need for examinations at what one might call 'operator' level, with the age of candidates tending to be somewhat higher.

He asked whether the separate utilisation section of the Institution examination would encourage a greater proportional qualification on this increasingly important side of the industry's business.

Mr. W. F. Pritchard, Eastern Gas Board, referring to the changing pattern of the gas industry, said that this trend would be more and more towards chemical engineering for those connected with gas manufacture, though distribution engineering would remain linked to civil engineering. Nevertheless as members of the gas industry their primary loyalty must be to the Institution of Gas Engineers.

In administering its education scheme the Institution's job was made most difficult by gas industry being spread thinly throughout the country as a whole, which made it a difficult job to fill each course to a reasonable capacity. This aspect alone had and would continue to ensure that sandwich courses became the principal method of training gas engineers.

GAS ON THE CONTINENT

French State-directed Prices Rise

IN spite of the promised relaxations it is only too certain that the monetary, fiscal and economic steps taken by the Government at the end of December will have far-reaching repercussions and no doubt the year 1959 will be distinguished from those which preceded it and also from those who follow it as a period of austerity particularly painful to live through. In spite of the efforts of the authorities prices have already reacted to the steps taken and show increases by no means negligible, while the resources of the national treasury remain limited.

So begins the editorial of February's issue of the French *Journal*. The Editor proceeds to outline the efforts of the commercial section of Gas de France to fight back, but his first announcement is of a rise in the State-directed selling prices of gas by 6.87%, although the average increase will not exceed 4.5%.

Reforming Tail Gases

M. Jean Bianchi, Chief of No. 1 Mediterranean Group of Gas de France, describes the methods used in the reforming of tail gases and their distribution over the maritime region from Sète eastwards to Toulon and just beyond. In this region there are four refineries which have been reconstructed and modernised since the war; their total capacity exceeded 10 mill. metric tons of crude oil in 1956. Tail gases available for gas-making represent about 1.5% by weight of the crude oil treated. They are used over an area including Toulon, Marseilles, Nimes and Montpellier. It is estimated that the total gas consumption will attain 860 mill. thermies (34.4 mill. therms) in 1961.

Peak Load Plant

At Marseilles, where there is already extensive modern carbonising plant, two reforming plants using steam and air over a catalyst have been installed as peak load plant. This is to be followed by two lines of Onia-Gegi plant with a capacity of 100,000 cu. m. per day each. The gases from the refineries contain little H_2S but 20 to 30 mg. per cu. m. of organic sulphur. They are therefore purified before cracking. The apparatus consists of two towers circulating counter-current, first a solution of soda (40 grains per litre) to retain the last traces of H_2S, then a solution of soda-plumbite (140 grains per litre) and cresol which retains the mercaptans. This solution is periodically revivified by air.

At Montepellier there are two lines each 50,000 cu. m.

per day of gas enriched to 4,200 cal. per cu. m. 440 B.t.u. per cu.ft.) by refinery gas, propane or butane. A third identical line is in course of erection. The crude refinery gas is purified by the soda and soda-plumbite as at Marseilles but H_2S is removed by dry purification in towers.

Sète is an experimental station of the Research Department of Gaz de France where a number of processes for the reforming of refinery gases, propane, butane and light oils have been tried out. These experiments have been described from time to time in papers presented to the A.T.G. and in the technical press. The gasworks itself is equipped with a plant constructed by the Ste. Stein & Roubaix for a capacity of 30,000 cu. m. per day (say 1 mill. cu.ft.) at 4,700 kcal per cu. m. (say 490 B.t.u. per cu.ft.); after some modification it has proved capable of 40,000 cu. m. per day.

'The originality of the process consists in a system of pyro-chronometric regulation; the times of blow and run on each cycle being determined by the temperature of the catalyser.'

H. & G. Installations

In the works of Marseilles, Nimes and Montpellier several lines of H. & G. carburetted water-gas plant have been modified to produce from tail gases, propane or butane, gas reformed by coke. The several reforming plants are described in some detail and results are given.

M. P. Albrieux discusses the actions of the external surroundings and of gas on piping and on joints with particular reference to the distribution system in and around Paris. The total length of this network is 4,900 km (about 3,000 miles). It is mostly of cast iron but there is also considerable steel, some of it bitumen-covered. Of the several destructive actions which are observed, two are very active—first electrolysis and then the effect of debenzolisation on rubber joints the consequences of which have been 'catastrophic'—two others, less spectacular but chronic, are the destruction of bitumen-covered lap-welded steel and the corrosion of cast-iron in some types of ground.

Mainly responsible for electrolysis is the 550-volt continuous current of the tramways. The principal victims of electrolysis are the lap-welded bitumen-covered iron pipes and the lead services. The current penetrates at the branching (the bitumen covering is insulating) and leaves at the same point, destroying both the branch and the iron pipe. All the cast-iron mains of the suburbs have rubber joints which act as insulators and the iron itself is not very sensitive to electrolysis. When however electrolysis does occur the characteristic craters are seen and, further, the loss of iron leaves a graphitic metal. These effects are discussed in detail. The total loss is very considerable.

The effect of benzole (and the absence of it) on rubber joints, particularly in the suburbs fed from Gennevilliers, has been studied historically. Before 1914 the benzole content of the gas was high. During the war benzole was recovered and this process was obligatory until the end of the War but it was resumed in 1926. In 1927 there was a notable increase in the destruction of rubber joints.

It has been shown that the joints were actually destroyed by the benzole 'and debenzolisation merely revealed this destruction.' Very large sums of money have been expended in replacing these joints. The new joints have not since been in contact with a gas rich in benzole and the system is now in good condition.

In the suburbs (whence the tramways have disappeared) electrolysis is now a thing of the past and the rubber joints, with rare exceptions are in good condition, the system having accommodated itself well to variations in the benzole content of the gas. In the South the system has carried without damage the mixture of gas from Alfortville and that from the east. In the whole region the loss of gas in 1956 was no more than 3.7%, a figure which is considered to be very satisfactory.

M. Jean Chazelle, Distribution Chief at Saint-Etienne, describes the space heating by gas-heated air mechanically circulated through a large block of flats, containing 40 dwellings on 11 floors. The installation has given satisfactory service over a period of six years. The heating unit consists of the following:

(a) An air inlet drawing air partly from below the floor at the southern facade of the building and partly through a grill in the entrance hall.

(b) An air filter.

(c) An electrically driven fan with a capacity of 1,000 cu. m. per hour (say 35,000 cu.ft.).

(d) A tubular heat interchanger with tubes 20 mm. diameter and white flame burners (rate at 4.2 cu. m. per hour, say 150 cu.ft.) below. Products of combustion pass through the tubes and air round them.

(e) A simple humidifier.

The installation is complete with ducts, controls and thermostats. The annual gas consumption was 13,756 thermies (say 550 therms) in 1957/8.

Dust and Fume Control

THE tenth conference of the British Occupational Hygiene Society, on 'the Control of Dust and Fume in Industry,' will be held on April 14-15, at Stephenson Hall (University of Sheffield), Oakholme Road, Sheffield, 10. The conference, which will be devoted to a discussion of the control of dust and fume in industry, is to be opened by H.M. Chief Inspector of Factories. Papers will be presented by speakers with experience of the subject in the cotton and asbestos industries, in iron foundries, in welding and electroplating. Non-members are eligible to attend this conference on payment of a registration fee. Those interested should apply to the Honorary Scientific Secretary, Dr. D. Turner, the Associated Ethyl Co., Ltd., Ellesmere Port, Cheshire.

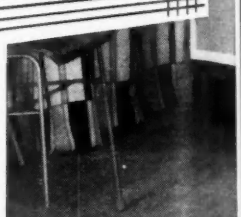
Longer Working Life

THE average expectation of working life at birth for males in Great Britain rose by 12½% between 1931 and 1955, according to figures prepared recently by the Ministry of Labour and National Service and published in a booklet, *The Length of Working Life of Males in Great Britain.* (Stationery Office, 3s. 6d. net.) A comparison of figures for these two years shows that this expectation at birth rose from 40.6 years to 45.6 years in that period.

Another Winner—

THE NEW WORLD

SEVENTY SEVEN



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3. Self-heated Warmer
4. Radoflex Burners
   Automatic Hotplate Ignition and taper
5. Large Oven with Drop Door
   and removable top lining
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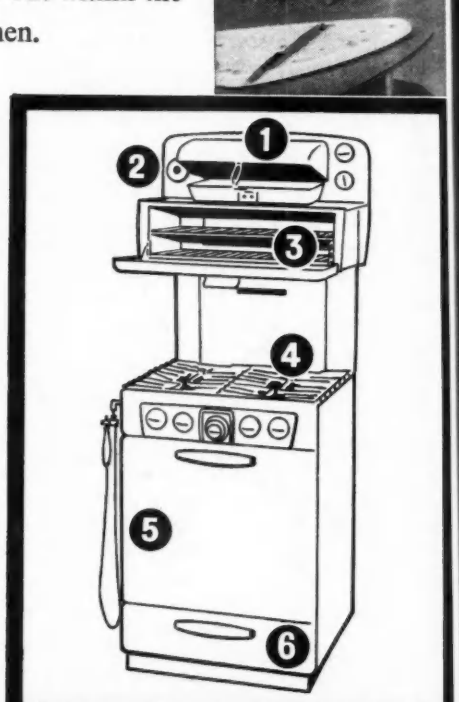

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From a paper to the Manchester District Junior Association of Gas Engineers, Liverpool, December 10, 1958.

The Cathodic Protection of Steel Gas Mains by the Sacrificial Anode

By E. TAYLOR,

TECHNICAL ASSISTANT, DISTRIBUTION DEPARTMENT, MANCHESTER GROUP.

ONE of the many problems facing a gas distribution engineer is how to prevent corrosion of buried steel mains. The external corrosion of an imperfectly protected steel pipeline buried in soil is a natural electrical phenomenon. Soluble salts, oxygen and water contents of soil set up local galvanic cells between different parts of the metal which are at different potentials to each other, ultimately causing deterioration of the pipe. Electric currents flow through the soil from the areas of high potential to the areas of low potential and return in the metal of the pipe to complete the circuit. The terms applied to the areas of high and low potential are the anode and the cathode electrodes respectively. Pitting occurs at the anode. Should this electrolytic action be allowed to continue, severe damage will be caused which will ultimately require the replacement of the pipelines.

An analogy of corrosion may be represented by the diagrammatic arrangement of a simple voltaic cell. Two dissimilar metal electrodes are immersed in a dilute acid electrolyte, when the electrodes namely, the copper cathode and the zinc anode, are connected across their terminals, electric currents flow in the electrolyte from the anode to the cathode, thus achieving a flow of current from the copper positive terminal to the zinc negative terminal in the external circuit. This type of cell is a primary cell, and the anode is regarded as the fuel for the cell as it has to be replaced periodically due to the surfaces being eaten away. Therefore, the following comparisons can be made:

1. The anodic region of the pipe with the zinc anode.
2. The cathodic region of the pipe with the copper cathode.
3. The soil with the dilute acid electrolyte.

Methods Available

Steel pipes are generally wrapped and coated by the manufacturer prior to delivery, and unless the protective servings are damaged during handling, installation, ground reinstatement, or by some other public utility attending their services, further protection against corrosion of the pipeline in high resistivity soils is unnecessary. Where, however, wrapped steel pipelines are laid in soil of low resistivity, further protection may be required to prevent corrosion. There are two electrical methods available, namely:

1. Sacrificial anode protection.
2. Power impressed protection.

It is intended to devote this paper to outline the principal features of the former method and to consider a practical application in gas distribution practice.

Sacrificial anode method of cathodic protection.—The object of cathodic protection is the artificial formation of a galvanic cell, incorporating the pipe to be protected as the cathode. A suitable anode (to be described later) is buried adjacent to, and level with, the invert of the pipeline. A connection is made between the anode and the pipeline. Mitigation of pipe corrosion can be achieved by neutralising all the anodic regions of the pipeline. Therefore, the solution of this problem is the provision of a number of sacrificial anodes of sufficient potential to eliminate all the pipe surface anodes. When the circuit is commissioned, a positive direct current will flow from the anode to any minute exposed area of pipe metal, hereafter termed a 'holiday.' The coating and wrappings of pipes are not hermetic, but an electrical detector applied to the servings will indicate the existence of any holidays. Further wrapping can reduce these, but even so there will be large numbers remaining in the servings.

The total area of exposed metal, together with the ground resistivity, are principal factors which determine the longitudinal spacing of the anodes and also the current supplied by each anode. Naturally, surveys of ground resistivity and soil analysis are obtained prior to deciding the anode spacing. Generally, the lower the resistivity of the soil, the wider is the spacing of the anodes.

TABLE 1

Metal	Standard potential (relative to the normal hydrogen electrode)
	Volts
Silver	+0·80
Copper	+0·34
Hydrogen	0
Lead	−0·12
Iron	−0·44
Zinc	−0·76
Aluminium	−1·67
Magnesium	−2·34

Selection from the Potential Series Table.

Table 1 shows a selection from the potential series of metals. Metals of a positive potential are more resistant to corrosion than those of a negative potential. The latter are more liable to corrode and, therefore, are the ones utilised for sacrificial anodes. Zinc and mag-

nesium are commonly used, but aluminium may be used in some instances. Table 2 shows the comparative anode characteristics for magnesium and zinc. Magnesium has the following advantages over the other anodes:

1. The greatest potential difference from the pipe material.
2. High electro chemical equivalent (ampère hours per pound of metal).
3. It does not suffer seriously from polarisation which would reduce the current flow.
4. Widest range of practical application.

TABLE 2

	Magnesium	Zinc.
Effective driving voltage	0·85	0·25
Theoretical charge: amp. hour per lb.	1,000	372
Actual charge : amp. hour per lb.	100—600	335
Anode efficiency	10%—60%	90%
Metal consumption: lb. per amp. yr.	3.04 of 60%	5·4

Comparative Anode Data for Galvanic Anodes.

In certain soils the anode may be surrounded with a backfill of powdered gypsum, bentonite and sodium sulphate, suitably consolidated and enclosed in a cloth sack. This arrangement is termed a packaged anode and is usually used in high resistivity soils to retain moisture and to allow a constant emission of current from the surface of the anode. Furthermore, packaged anodes may be used if there are indications of industrial effluents or ground of a peaty nature. These conditions would be detrimental to the life of unpackaged anodes. Unpackaged anodes may be used in soils of low resistivity and wet conditions.

It is essential to have complete electrical continuity at the connection of cable to pipe. The 'cathweld' process is an effective method, and the procedure is as follows:

1. Bare and clean the pipe at location of weld.
2. Locate the carbon box containing the thermit on the main.
3. Insert the cable lead into the box until it contacts the pipe surface.
4. Ignite the thermit with a special cartridge thus completing the weld.
5. Remove the carbon box and completely insulate the weld and pipe surface with a suitable material.

This method is used for steel mains above 3 in. in diameter. A circular clip is sweated to pipes of smaller diameter and the cable is attached to this clip.

Advantages

The normal procedure for the measurement of metal/soil potential is to connect the negative terminal of a high resistance voltmeter to the pipe and the positive terminal to a standard half cell of the copper/copper sulphate type, which is placed in the ground near the pipeline. The protection of steel in an aggressive soil is achieved if the metal/soil potential is more negative than −.85 volts or −.95 volts for soils of anærobic conditions. These are regarded as suitable for practical applications of cathodic protection. The advantages of sacrificial anode protection are; (a) it can be used where no electrical power is available; (b) it is simple to install; (c) it can be applied to localised areas of low resistivity ground; (d) the small current output renders the method less liable to cause interference to other metallic structures in congested areas.

Economic Protection

The precautions which have to be observed to ensure economic protection are:

1. Limit the use to soils below 3,000 ohms per cu. cm. resistivity.
2. Notify all other utilities of proposed installation.
3. Sacrificial anodes corrode at different rates, therefore, care has to be taken for selective replacement.
4. Location details of anodes, test points and insulated and bonded joints have to be recorded.
5. Periodic testing of above is essential or the installation may become ineffective.
6. Ensure complete electrical continuity of length of main to be protected but insulate the joints to portions of unprotected mains. The electrical continuity is ascertained by bonding any Johnson Couplings or other joints in the line of mains.
7. Pipe servings must be as sound as possible.
8. There must be no electrical connection with any other buried structure.

An application of sacrificial Anode Installation.—In May, 1956, a site survey for a special steel main crossing in the bed of the River Wharfe at Wetherby, Yorkshire was undertaken. The installation of mains consisted of two 12¾ in. o.d. seamless steel tubes, wrapped and coated, with flanges welded at each end and a specially constructed syphon welded in each pipe. The pipes were lowered into an excavation in the river bed and connected with cast iron flanged specials to a 15 in. bore h.p. main at each bank of the river. It will be appreciated that an installation of this nature cannot be renewed without great difficulty and expense. Protection was provided in the form of wrapping hot bitumastic and concrete sprayed on to a reinforcing mesh of steel. In addition, sacrificial anode protection was advised since site conditions were suitable. Protection was applied by two identical installations, each consisting of five zinc anodes on a common lead cable connected through a test box and attached to a steel bar welded between the two steel mains. Each zinc anode weighed 33 lb. and measured 1.4 in. by 1.4 in. by 60 in. long. They were the packaged type and were connected to the common lead cable (7/.064 in.) at 10 ft. centres. To insulate the steel mains from the C.I. pipeline, dielectric joint packing rings were inserted in two flanges at each end of the independent pipes.

A temporary float was constructed of ladders and the anodes and cable positioned on it. The whole unit was suspended at water level from the jib of an excavator and navigated down-stream into a suitable position prior to being submerged to the river bed. A diver removed the anodes from their supporting structure and buried them below the pipe level.

Potential tests after commissioning the installation gave an indication of the success of the protection, thus justifying the additional expenditure involved and furthermore ensuring a leakage free lifetime of gas transmission, through the special crossing.